(12) UK Patent Application (19) GB (11) 2 308 528 (13) A

(43) Date of A Publication 25.06.1997

(21) Application No 9526041.0

(22) Date of Filing 20.12.1995

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(51) INT CL[6]
H04Q 7/22 7/32

(52) UK CL (Edition O)
H4L LDSX LECC L1H10

(56) Documents Cited
GB 2267794 A GB 2265522 A EP 0538933 A1
WO 95/28062 A2 WO 94/11849 A1 WO 92/06549 A1

(58) Field of Search
UK CL (Edition N) H4L LDSK LDSX LECC
INT CL[6] H04Q 7/22 7/32 7/38
ONLINE: WPI

(54) Mobile Telephone Using SIM Card Storing Prepaid Units

(57) A mobile telephone is operated using a SIM card which holds prepaid credit units. On entry of a correct user code, a call is connected and the number of credit units used is deducted from the stored number and the remaining credits displayed. Credit units may be recharged by the service supplier and the SIM card re-used.

GB 2 308 528 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

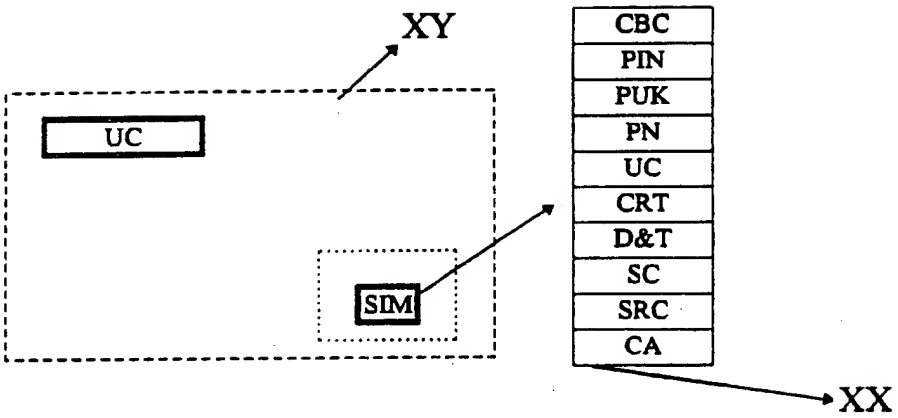
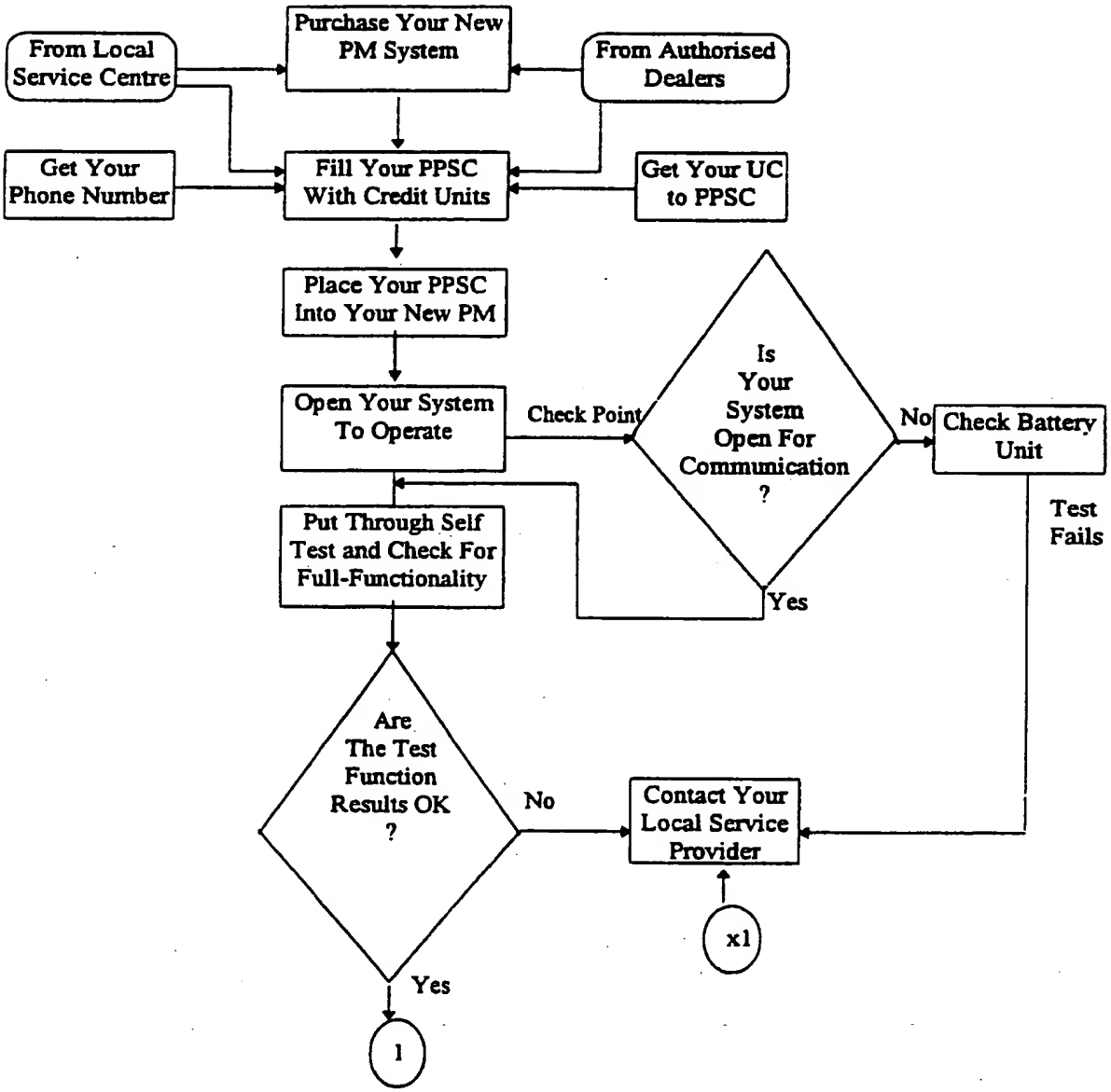
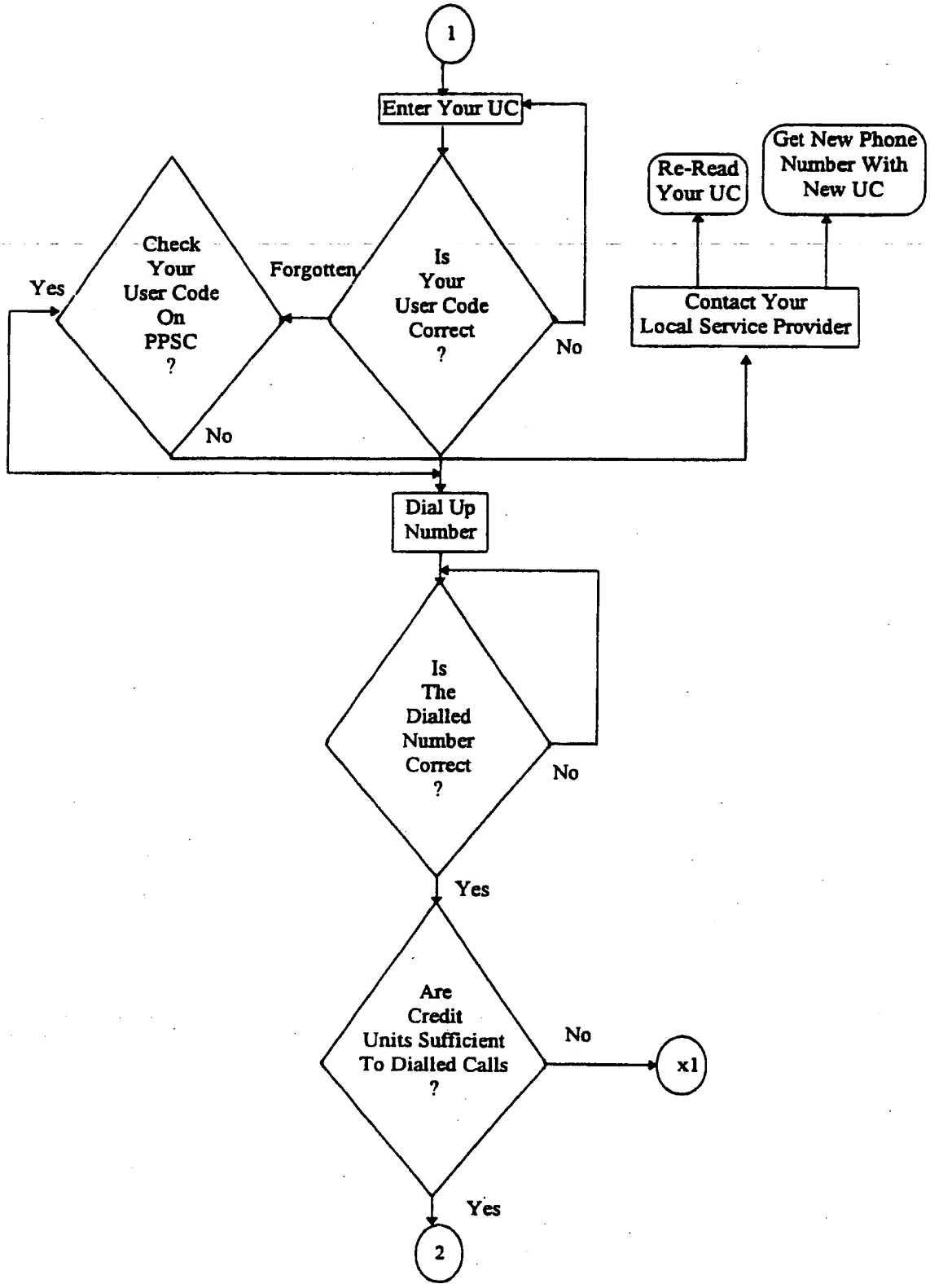


FIG. 1


From Local Service Centre
Purchase Your New PM System
From Authorised Dealers
Get Your Phone Number
Fill Your PPSC With Credit Units
Get Your UC to PPSC
Place Your PPSC Into Your New PM
Open Your System To Operate
Check Point
Is Your System Open For Communication ?
No
Check Battery Unit
Test Fails
Yes
Put Through Self Test and Check For Full-Functionality
Are The Test Function Results OK ?
No
Contact Your Local Service Provider
x1
Yes
1


1
Enter Your UC
Is Your User Code Correct ?
Forgotten
Check Your User Code On PPSC ?
Yes
No
No
Re-Read Your UC
Get New Phone Number With New UC
Contact Your Local Service Provider
Dial Up Number
Is The Dialled Number Correct ?
No
Yes
Are Credit Units Sufficient To Dialled Calls ?
No
x1
Yes
2

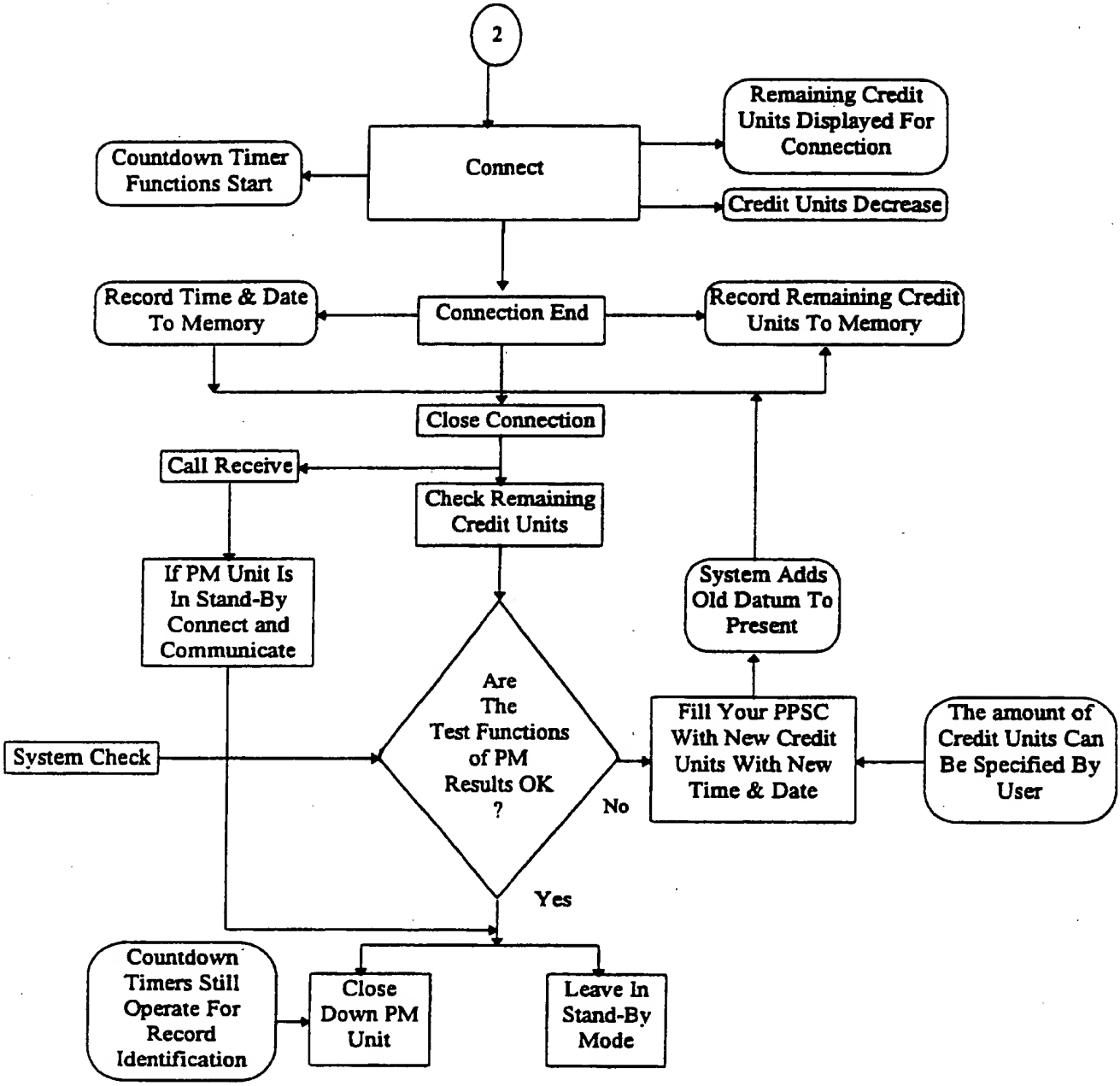

2
Connect
Remaining Credit Units Displayed For Connection
Credit Units Decrease
Countdown Timer Functions Start
Record Time & Date To Memory
Connection End
Record Remaining Credit Units To Memory
Close Connection
Call Receive
Check Remaining Credit Units
If PM Unit Is In Stand-By Connect and Communicate
System Adds Old Datum To Present
Are The Test Functions of PM Results OK ?
No
Fill Your PPSC With New Credit Units With New Time & Date
The amount of Credit Units Can Be Specified By User
System Check
Yes
Countdown Timers Still Operate For Record Identification
Close Down PM Unit
Leave In Stand-By Mode

FIG. 2

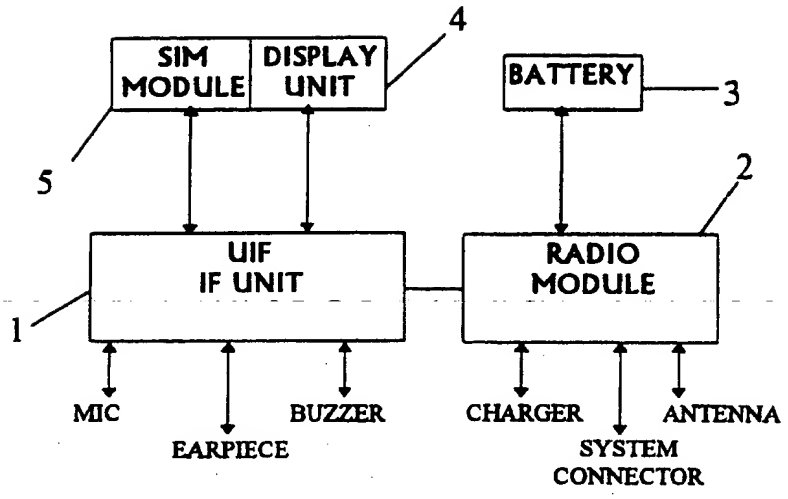

SIM MODULE
DISPLAY UNIT
4
BATTERY
3
5
2
UIF IF UNIT
RADIO MODULE
1
MIC
EARPIECE
BUZZER
CHARGER
SYSTEM CONNECTOR
ANTENNA

FIG. 3

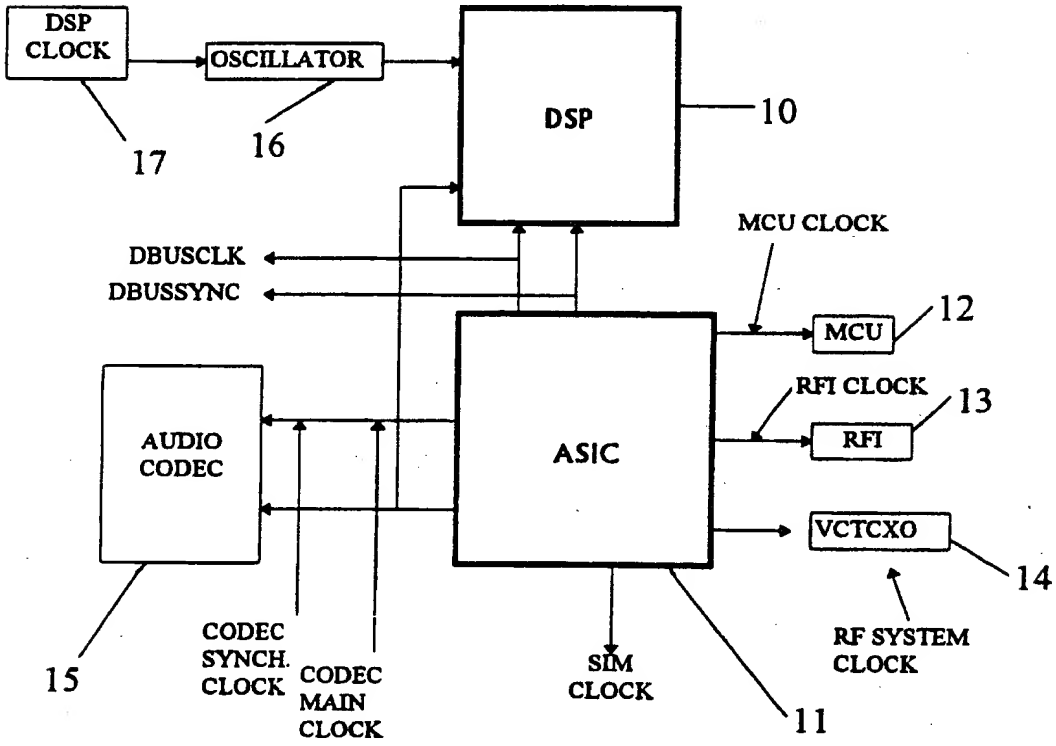

DSP CLOCK
OSCILLATOR
17
16
DSP
10
MCU CLOCK
DBUSCLK
DBUSSYNC
MCU
12
RFI CLOCK
13
RFI
AUDIO CODEC
ASIC
VCTCXO
14
15
CODEC SYNCH. CLOCK
CODEC MAIN CLOCK
SIM CLOCK
11
RF SYSTEM CLOCK

FIG. 4

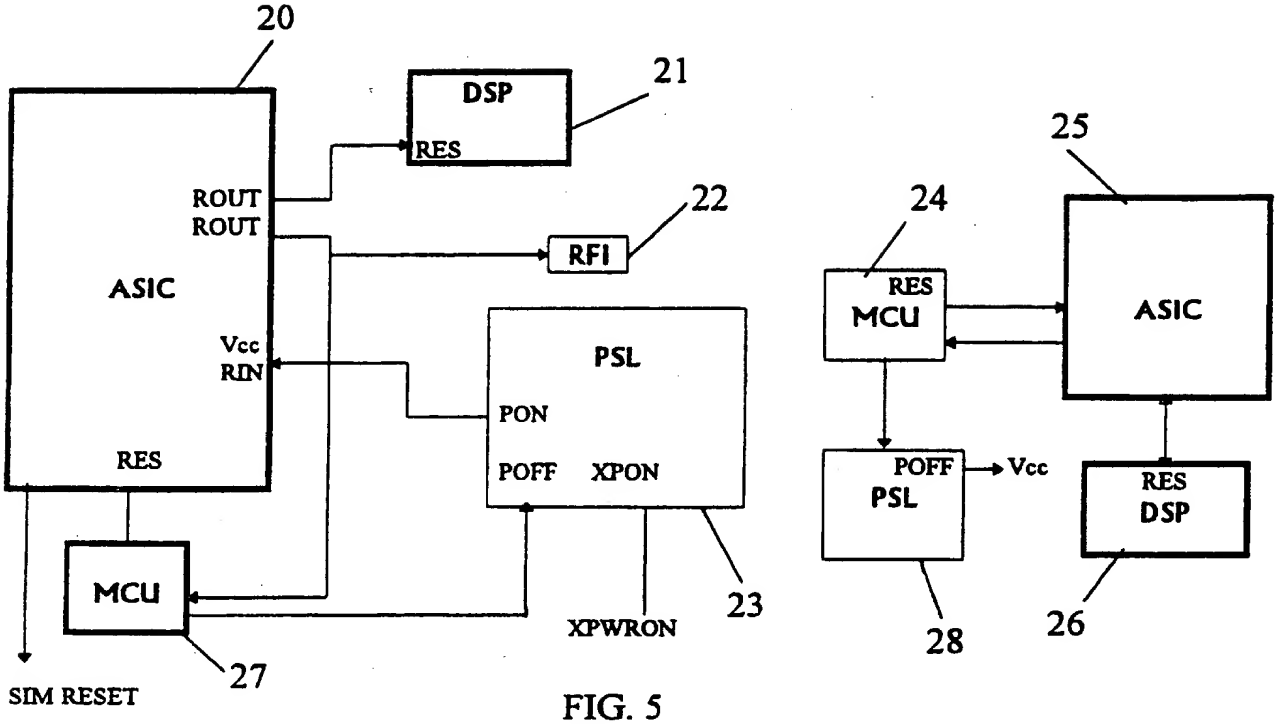

20
DSP
21
RES
ROUT
ROUT
22
RFI
ASIC
Vcc
RIN
PSL
PON
POFF
XPON
RES
MCU
23
XPWRON
27
SIM RESET
25
24
RES
MCU
ASIC
POFF
Vcc
PSL
RES
DSP
28
26

FIG. 5

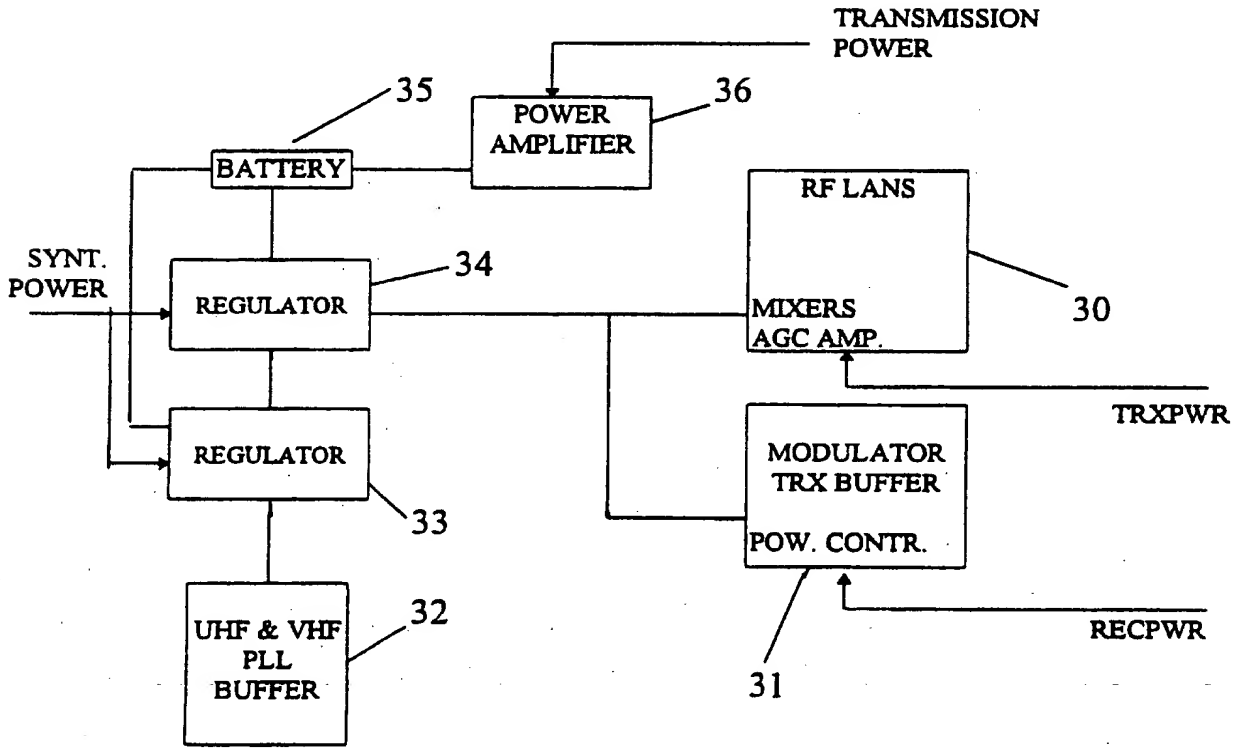

TRANSMISSION
POWER
35
POWER
AMPLIFIER
36
BATTERY
RF LANS
SYNT.
POWER
34
REGULATOR
MIXERS
AGC AMP.
30
TRXPWR
REGULATOR
MODULATOR
TRX BUFFER
33
POW. CONTR.
UHF & VHF
PLL
BUFFER
32
RECPWR
31

FIG. 6

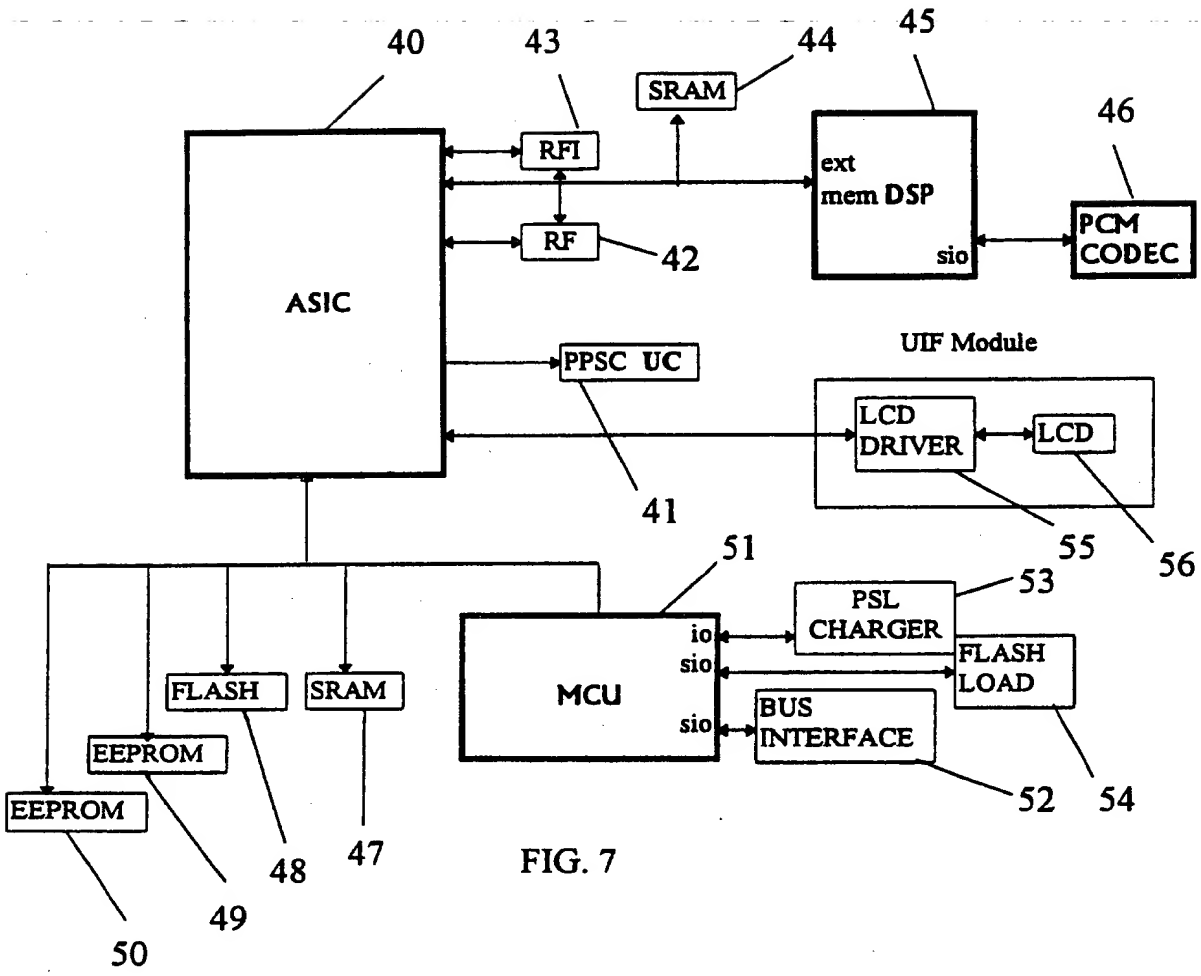

40
43
44
45
46
SRAM
RFI
ext
mem DSP
PCM
CODEC
RF
42
sio
ASIC
PPSC UC
UIF Module
LCD
DRIVER
LCD
41
55
56
51
53
PSL
CHARGER
io
sio
FLASH
LOAD
FLASH
SRAM
MCU
sio
BUS
INTERFACE
EEPROM
EEPROM
52
54
48
47
49
50

FIG. 7

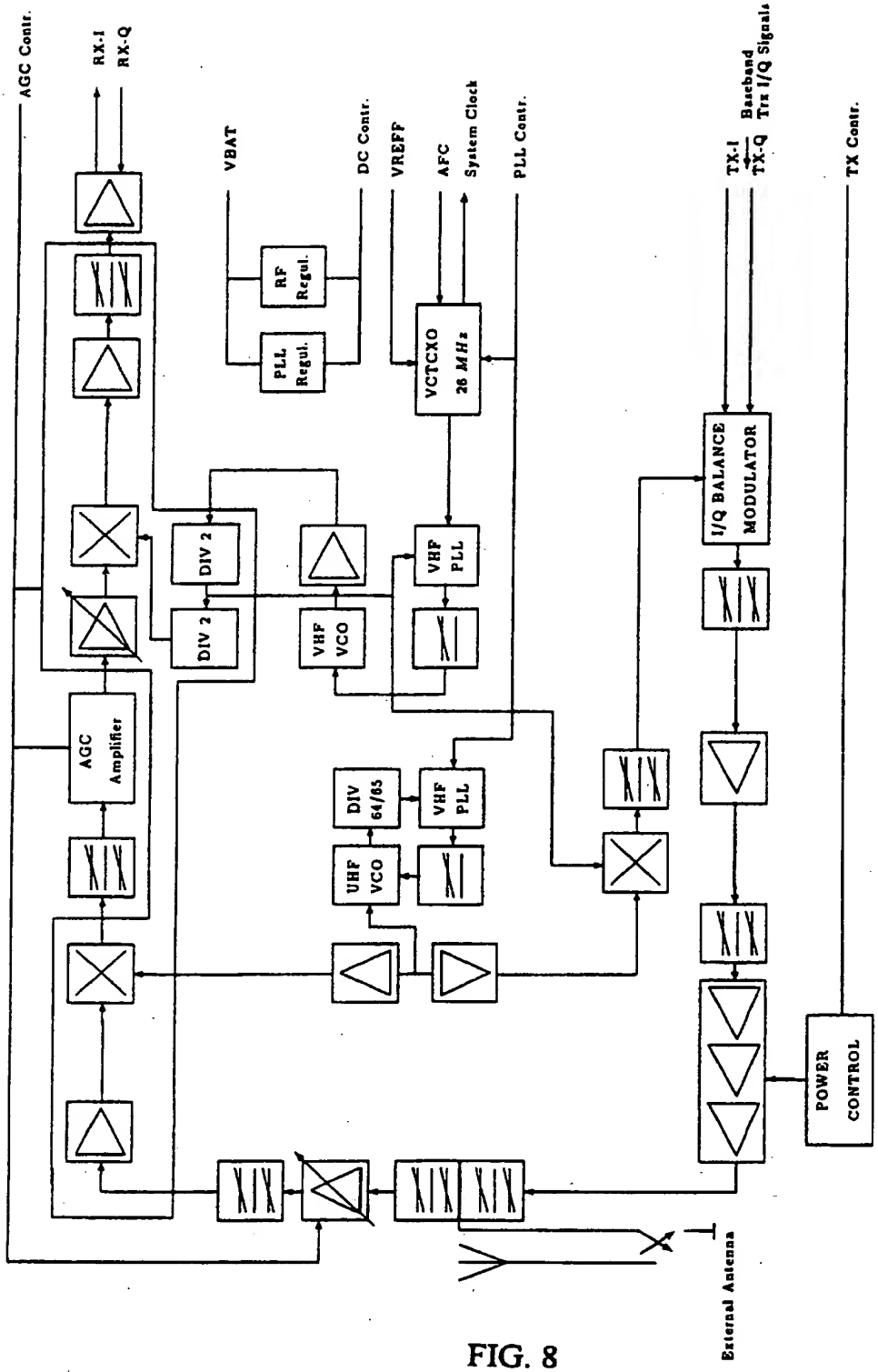

AGC Contr.
RX-I
RX-Q
VBAT
DC Contr.
VREFF
AFC
System Clock
PLL Contr.
TX-I
TX-Q
Baseband Trx I/Q Signals
TX Contr.
RF Regul.
PLL Regul.
VCTCXO 26 MHz
I/Q BALANCE MODULATOR
DIV 2
DIV 2
VHF PLL
VHF VCO
AGC Amplifier
DIV 64/65
VHF PLL
UHF VCO
POWER CONTROL
External Antenna

FIG. 8

PATENT SPECIFICATION

DRAWINGS ATTACHED

2308528

COMPLETE SPECIFICATION

The New Pay Mobile (PM) System For Use In Updating The Credit Value of a Pre-Paid SIM Card (PPSC).

Speech communications is at present the most dominant and common service in telecommunications networks. The fact that commercial and private usage of telephony in its various forms constitute to growth even a century after its popularity as a form of communication. This popularity has been forecasted to remain steady for the foreseeable future. The traditional plain analogue system has served the telephony systems remarkably well considering its technological simplicity. However, modern information technology requirements have introduced the need for a more robust and flexible alternative to the analogue systems.

The attractions of digitally encoded and decoded speech are obvious. A digital system ultimately considers down to a binary sequence. All of the advantages offered by digital systems are available for exploration. These include the case of exploration, signalling, flexibility, security, and integration into the evolving ISDN (Integrated Services Digital Network). The 64 kb/s Log PCM (Pulse Code Modulation) and 32 kb/s ADPCM (Adaptive Differential PCM) systems, which have served the many early generations of digital systems well over the years, have therefore been found to be inadequate in terms of spectrum efficiency when applied to newer bandwidth limited communication systems, e.g. satellite communications, digital mobile radio systems and private networks. For digitised speech, the signal compression is achieved via elaborate digital signal processing techniques. This is facilitated by the rapid improvement in digital hardware which has enabled the use of sophisticated digital signal processing techniques that were previously infeasable.

In addition to the required low bit rate for spectral efficiency, cost and power requirements of the speech encoder/decoder hardware are important where hand held telephones are used, the battery consumption, cost and size of the portable equipment have to be reasonable in order to make the product widely acceptable. It is usually accepted that during the prototyping of a speech coder highly cost DSPs (Digital Signal Processor's) can be used. Even at this stage the number of DSPs used to implement the system is usually limited to no more than about four; two for the speech encoder/decoder, and two for the channel (FEC (Forward Error Control))encoder/decoder. However, the final production of the equipment should be in ASIC (Application Specific Integrated Circuit) so that the power, size, and most importantly the cost is minimised.

A real time process in mobile systems is a task which needs to be performed within a specified time limit. The limit may vary from an order of 200 *ns* to values upto 20 or 30 *ms*. In digital newly developed mobile systems of coders such as CELP (Code-Excited Linear Predictive Coding), the coding process is performed on a block by block basis with typical main block lengths of 20 - 30 *ms* (frame time) , and minor block lengths of 4 - 8 *ms* (subframe), increasing the time limit allowed. Any speech coding algorithm can be implemented using available DSP chip technology. In parallel with the advances in the speech coding algorithm development, DSP technology has shown significant advantages. The availability of every powerful fixed and floating point DSPs has paved the way for the real time implementation of highly complex speech coding algorithms. The fixed-point DSPs tend to be faster and cheaper, but more difficult to program and less-precise.

The selection of a DSP for the implementation of a specific speech coding algorithm is affected by other factors as well. One is the instruction cycle time of the DSP, and the other is the suitability of its instruction set for the main processing blocks. In CELP type algorithms most of the DSP processing time is taken up by the multiply and add type instructions. The other useful features of the DSP are: the amount of on-chip RAM/ROM (Random Access Memory/Read Only Memory); programming and data bus structure; off-chip memory capacity; boot memory controller; on-chip peripherals; fixed and floating point arithmetic capability; on-chip cache; addressing modes; on-chip DMA (Direct Memory Access); internal and external interrupts; hardware/software programmable wait states; on-chip emulation points; power capability; and power dissipation.

Digital encoding of voiceband speech has been a topic of research for over three decades, and as a result of this intensive activity, many strategies and approaches have been developed for speech encoding. As these strategies and techniques mature the standardisation followed with specific application targets.

ADVANCED MOBILE COMMUNICATION NETWORKS

The prominent service of public cellular systems is speech, the aim of which is to provide ubiquitous interpersonal communications. The search for a good compromise between the system, service for the users, and together with quality of these services seen by the users. By design GSM (Global System For Mobile Communication) system can accept different speech encoding algorithms. The GSM standards offers the possibility to support packet services, by access to X.25, PSPDN (Packet Switched Packet Data Networks). There also exists in the GSM a true packet switched service which is adapted to infrequent transmission. GSM has also incorporated most of the facilities offered by ISDN. However, new facilities are introduced in wireline systems and new ones can be adapted for cellular

systems. GSM being bound to provide a wide continuous coverage with a corresponding widespread infrastructure many ideas exist to those of the part of the GSM system to support other systems. The architectural approach of GSM with clear cut separation of functionalities, is well accepted to the borrowing of parts.

The demand for wireless communication services continues to increase, cellular carriers are looking towards digital implementation for increased capacity, better performance and a wider offering of services to mobile users.

Given that the existing network infrastructure was designed primarily for voice services, and integrated voice/data channel access protocol, compatible with the existing voice protocol, offers a low cost way to capture the large and ever growing market for mobile data services such as messaging, terminal-to-host, fixed services, facsimile, and compressed video image transfer.

The growing development of personal communication networks places an increasingly strong demand on spectrum efficiency. A very promising way of achieving a significant capacity increase is the adaptation of microcells in the near future.

THE NEW PAY MOBILE SYSTEM

The phone payment cards that have been introduced are easy to use and carry a credit value facilitating a coin free card-phone. They became out of use on expiry in spite of wide use for ease of communication. However these cards are produced in different forms by the manufacturers leading to smaller in size and ease-in-use.

In an embodiment of the present invention to be described, there is provided a implementation and application areas in mobile phones for the use of the facilities pre-paid SIM (Subscriber Identity Module) card PPSC accounts to charge the user for updating his/her reusable PM PPSC. The PM functionality is based on updating the PPSC's credit units with no need for coin slot to be mounted on the PM system, thus maintaining their features and advantages. The action of updating is by placing the PPSC into the PM. The invention provides a configuration to facilitate the use of PPSC for charging the user through a software task under the control of the microprocessor element residing in the PM. The use of current size of phone payment cards is of importance in enabling the major parts of the PM mechanism to be used in particular embodiment.

AN embodiment of the invention will now be described, by way of examples, with reference to accompanying drawings in which:-

Figure 1 shows the PPSC model;
Figure 2 illustrates the flowchart of the PM operation;
Figure 3 shows the transceiver block module;
Figure 4 shows the baseband clocking;
Figure 5 shows the eyedog diagram;
Figure 6 shows the power dissipation unit;
Figure 7 illustrates the baseband block diagram, and
Figure 8 shows the RF block diagram.

The new Pay Mobile PPSC is a new platform and design in mobile communication systems. The new PM will allow users to communicate via the available credits available on their new PPSC. The new PPSC is flexible in its design module, and aim to gain control in mobile communication standards available today and in the near future. The new facilities and availabilities offered by the PM system introduces reliable and flexible control in mobile communication networks. The security level designed with the new PM system model enables users to communicate in a reliable and secure way.

The new PPSC operates on itemised billing system for which users can only talk for what they pay. The new PPSC consists of a unique ID number (namely as the mobile phone

number), User Code (UC), Personal Identity Code (PIN), Security Code (SC), an amount of credits, and date and time of the credits that the PPSC was charged. The phone number is the PPSC identity number, it's service specific. It can be renewed by the local service providers as requested with payment. The UC is a code given to users to operate their new PM system. For security reasons, the UC is a code sequence identical to the code sequence of the mobile's ID, and is indicated on the PPSC. The PIN code is required to identify the card identity code. This is mainly used block the card if the user code is incorrectly entered more than three times. The SC is used to change phone setting to open international communication links. The PPSC credits indicate the allowable talk time of the PPSC represented by units. It can be charged upon payment, stating the date and time.

When the user purchases the new PM, the talk time credits and the air time charge is inclusive. The user is given a new PPSC together with the UC. For the first entry of the PPSC into the PM, the phone requests for the UC for service connection. If the UC is entered incorrectly, the phone will not function to communicate. It will simply be locked unless the correct user code is entered. Once the correct code is entered, the PM will open for communication, by recording the amount of credits, date, and time, and UC indicated on the PPSC. When the PM records the information on the PPSC, the time functions of the PM are activated. When call-connection is established, the amount of credits used is decreased internally by the PM, and the remaining credits remain in the PM's memory. No remaining credit units are stored on the PPSC, once credit units decreases. Users are able to recharge their credit units on the PPSC and insert it again on the PM. The reference unit in the PM relates to the date and time of the purchased credits. The PM is capable of adding the previous credit units to the newly charged credits. Therefore users do not lose their previous credits. Whatever the credits charge time is, the PM will continue to record each credit which is purchased. The PM also displays the remaining unit(s) of credits left, and the charge/credit units. Since no information is passed back to PPSC when the connection is terminated, the timer units inside the PM stores these records for references. But one might ask, can I use the credits available on this PPSC on another phone? The answer would be YES under certain conditions.

The new PM together with PPSC is a new generation in mobile communication systems providing high security standards in communication links. On first entry of the PPSC to the PM, and correct entrance of the UC, the PM's security system is activated by generating a Service Code internally. The generated SC is the actual phone number to be transmitted by the PM. This is the protection feature for user identification of the PPSC on other phones. The credit units on the PPSC can be used on another PM system. The service code inside the PM is unique, and must be identical to the valid UC on the PPSC. Every UC, and PM

system purchased has unique ID reference codes, authorised under the control of local service providers. Additionally, PM users can record specific UCs onto the PM memory to allow other PPSC's to be used in that PM. For example, the PM accepts a record of UCs that the PM owner specifies, such as to lend his/her friend to use the credits on his/her PPSC on the PM intended.

If users wish to sell their PPSC to other users, they must give their own UC with the PM. If the PPSC gets stolen, it cannot be used on other PM system unless the UC for that PM system to be used is known. Simply the UC and the match ID code of the PM should match to initiate communication. Every time the PPSC is inserted in the PM the UC is requested from the user. The UC together with the SIM is included on the PPSC. This is shown in figure 1.

The SIM contains information relating to phone number, UC, PIN, SC, date and time of credits purchased, and code blocks. When the SIM card is placed into the PM, the Identity Card (IDC) includes the UC indicated on the card. If the users lose or forget their UC, they have to re-read the UC from the PM from their local service providers. In this instance there would be a charge by the service providers to supply this information which would be the same as charging the PPSC phone number. This prevents users activating to use the PPSC on any other PM systems. This can only be obtained from their local service providers. The difference between re-reading the forgotten UC from the PPSC, and having a new phone number is that users can still use the remaining credits on the forgotten UC belonging to PPSC.

If the user runs out of credits at some instant where he/she cannot access local service centres (i.e. during night time), the PM emergency service can be used for which an specific amount of credits can be borrowed from the PM memory. These borrowed credits, are automatically dropped down credit units when the user purchases new credit units. The amount of credit units that can be borrowed from the PM's memory is limited to the number of credits functionally programmed by the PM.

The functions of the new PM system is summarised in figure 2. Some of the general functions included in the new PM system are: Credit Unit Display, Duration & Cost, Message Handling, In-Call Options, Fax or Data Call, Security Options, Call Listing, Call Diversion, Network Selection, Memory Functions, Number Edition, Personal Reminders, etc.

The PM system greatly increases both the ease in usage of the SIM cards and the security standards of communication links available today. When users purchase their new PM system, the air and talk time is included within the system. Thus they pay beforehand to who they are intending communicate in standardised secure and feasible way.

TECHNICAL DOCUMENTATION

The Transceiver Module

The transceiver AX consist of 3 modules: System Module 2, User I/F 1 module, and mechanical 3,4,5 module as indicated in figure 2.

External signals and connectors to the UIF 1 (User Interface) module are the display module 4 connector and UIF connector. The UIF connector consists of supply voltage, battery voltage, ground microphone, earpiece, PWM signal buzzer control, SIM voltage supply control, serial data for SIM and clock data for SIM.

Functional Descriptions

1. The transceiver AX consists of Radio Module 2 and a UIF 1 module.
2. The system blocks and RF 2 (Radio Frequency) blocks are interconnected with PCB (Printed Circuit Board) wiring.
3. The system blocks provide MCU 12 (Microcontroller Unit) and DSP 10 environments, EDSA (memories and logic control IC), memories, audio processing and RFI (Radio Frequency Interface Unit).
4. RF 13 block is designed for the handportable phone.
5. The microcontroller communicates with DSP 10, memories, and EDSA.
6. The RF 12 block receives and modulates radio frequency signals and transmit a modulated RF signal.

System Module

1. The system module AX is composed of external bottom connector, and internal UIF module connector.
2. The system module is the baseband receiver.
3. Its functionality is to carry out all the system and the RF functions of the transceiver.
4. The radio unit 2 contains separating walls for the baseband RF 12 and the connections are fed through the bottom connector of the radio.
5. Connections to UIF 1 are fed through the flex and hence there is no physical connector between RF and the baseband.

Baseband Module : Functional Description

1. Purpose : To control the phone and process audio signals to and from RF 2.
2. Operation Modes : Active Mode, Idle Mode, and Power off Mode.

Power Control

1. Supply power activated by PWR (Power) key : activation by PSL 18 (Power Supply).
2. Reset to ASIC 20 power up by PSL 18.
3. Clocks to DSP 21, and MCU 24 are provided by ASIC 20.
4. MCU 27 detects the PWR on, cuts outgoing calls and leaves PSL 18 eyedog without reset.

Operation Modes of The Eyedog System

1. MCU 24 starts testing the DSP 21.
2. If test results are OK, ASIC 20 eyedog timer is updated by MCU 24.
3. PSL 18 PON is activated by pulses from the MCU 27.

Phone Control Unit

1. The control unit is equipped with MCU 24, and its environment. Its environment consists of memory unit elements: EEPROM 49,50 (Electrically Erasable Programmable Read Only Memory), FLASH 48, and SRAM 47 (Static Random Access Memory).
2. The main features of the CTRLU (Control Unit) for MCU 51 functions are: UIF 1, Communication Control, RF Monitoring, Power Control, Battery Monitoring and charging Control, Flash Loading, System Control, Self-Test and Production Testing.
3. The MCU 51 blocks are composed of: CRTLU Accessories, CRTLU PWR Unit, CRTLU Audio, CRTLU ASIC, CRTLU DSPU, CRTLU RF/Battery Monitoring, MCU 51 Memories.

The eyedog timer is controlled by the MCU 24. A positive pulse is sent to POFF 28 by the MCU 51. The power will be removed from the system if MCU 24 fails to deliver the pulse. The MCU 24 also controls the power on/off switching. Main reset, clock and interrupts to the MCU 24 are controlled by ASIC 20. The DSP 21 and MCU 24 communicate through ASIC 20. The incoming data is written to DSP 21 mailbox via the MCU 24.

Power Supply Unit

1. The power supply unit (PWRU) provides the necessary supply voltages for the baseband BX includes the charging electronics.
2. The PWRU has voltage detection, internal eyedog, and charger detection functions.
3. The charging electronics of PWRU is controlled by the MCU 24.
4. The phone will detect the charging voltage and start the phone if phone is in power-off mode.

5. If the battery voltage is too low for the phone, the phone will enter the RESET state, and the charging control circuitry will pass the charging current to the battery.

Digital Signal Processing Unit (DSPU)

1. Main Interface Units to DSPU are : audio codec, DAI (digital audio interface), MCU 51 via ASIC, DBUS 52 (data bus interface for accessories), and ASIC 40.
2. DSPU 45 block main features: Adjacent cell monitoring, speech processing, reception test, functions channel coding and transmission and control, functions including RF and frame structure control.
3. The control unit communications with the DSPU circuitry through a mailbox in the ESA ASIC.
4. DSP 45 controls RF through ESA asic for which all necessary functions are implemented and control I/O (Input/Output) lines are provided for synte loading.
5. During transmission, DSP 45 codes the speech, and routes the resulting transmit slots to ESA.
6. The ADC 42 (Analogue-to-Digital Converter) in digital receive mode RFI 43 converts IF signal from RF unit controlled by ESA.
7. The RFC 40 (Radio Frequency Control) clock generates the required clock pulses to clocking units.

Audio Processing

1. The audio unit consists of peripheral components and audio codec.
2. Codec control is done by the MCU 51, and PCM 46 data received does to the DSP 45.
3. Audio codec communicates with DSP 45. This is done through a SIO 51. The audio codec functionality is controlled by the MCU 51 through a separate SIO 51.

The ASIC Unit

1. The binary functions of the ASIC 40 are : RF controls, SIM Interface, timers, Interface between MCU and UIF and hardware accelerator functions to DSP 45.
2. The RFC buffers the clock from VCTCXO 14 to ASIC.
3. The clock is buffered and divided for RFI 43, MCU 51, and audio codec 46 in ASIC 40.
4. In power saving mode DSP 45 oscillator can be stopped, and clock outputs can be disabled.

The RFI Unit

1. The RFI 43 unit consists of RFI-ASIC and voltage regulator. The RFI-ASIC 40 is a block interfacing unit between the RF and baseband.
2. The RFI-ASIC block has the following functionalities: AFC (automatic frequency control voltage) DAC, I and Q channel separation, IF receiving and ADC, digital AGC (Automatic Gain Control) through PDATA, and TXC (transmit power control voltage).
3. All the functions of the transceiver are carried out by the RF block.
4. There exists two regulators in the RF block . One of the regulators is used for the RF circuits and the other is used for the synthesisers.
5. Received RF signal from the antenna is fed via duplex filter to the receiver, where this signal is further amplified by a discrete low noise preamplifier.
6. The spurious emissions coming from the receiver unit and the spurious signals coming from the antenna are rejected by the filter network.
7. The IF signal is filtered by an SAW IF filter after the mixer. The amplified IF signal is down converted in the second mixer of the IC.
8. The discrete buffers amplifies the modulated signal from the modulator. The hybrid IC (Integrated Circuit) accepts the amplified transmitted signal. The power amplifier amplifies the signal to the predetermined output level. The duplex filter filters the output signal for which it is to be fed to the antenna.
9. The output power of the PA IC is adjusted by power control circuit. The output power and shape of the transmission pulse is controlled by this signal.
10. The voltage controlled temperature compensated crystal oscillator is the stable frequency for the synthesisers and the baseband circuits. Frequency of the crystal oscillator is controlled by AFC voltage brought from the RFI circuit.
11. The signal used for the second local signal for the receiver, the signal divided by two used for the synthesiser, and the up conversion is the VHF VCO (Voltage Controlled Oscillator) signal divided by four. Thus the VCO works at a fixed frequency which is controlled by the second synthesizer loop.
12. In the passive mixer the transmitter signal is generated. The RF filter filteres the UHF VCO signal and the VHF VCO signal divided by two and feeds into the modulator IC.

FUNCTIONAL OPERATION MODES OF THE PM

The information on the PPSC 41 is passed to the PM module via the ASIC 40. The MCU 51 unit contains a set of memory units for which the identification information on the PPSC 41 is stored. The MCU 51 reads/writes the necessary information to EEPROMs 49,50 using the bus interface unit parallelly connected to the ASIC - MCU 40,51.

The required check codes to establish link connections are stored in these EEPROMs 49,50 supplied by the local service providers. The EEPROMs 49,50 contains monitor sub programs, internal subroutines, user codes, service codes, phone ID codes, date and time. When users start to communicate, a user code is requested by the PM. This code is entered from the keyboard of the mobile. The MCU 51 via the ASIC 40 records this code to temporary data memory of the EEPROM 49 at selective address locations. It then compares this code with the match ID code of the PM reference number. If the two ID's don't match, the MCU 51 again requests the correct UC from the user. At this stage, on wrong code entrance puts the clock signals in halt mode. The clocking circuitry will not start to oscillate. The clocking system is the hart of the PM module. The corresponding units operation depends on this UC XY verification. On several wrong code entrance, the oscillations will result to block the ASIC 40 unit for which the card will totally be blocked.

On correct code entrance, the MCU 51 communicates via ASIC 40 to store the correct code to the EPROMs 49,50. If newly entered code is verified, clocking circuitry is enabled. The PM system then reads the phone number on the PPSC 41 via ASIC 40. This number is temporarily stored to the EEPROMs 49,50. The MCU 51 activates the algorithms which is used to generate the service code valid in the EEPROMs 49,50. The DSP 45 communicates with the MCU 51 via the ASIC 40 to receive these codes, and generates the encrypted service code to establish the link connection for the PM. Once the service code is generated by the DSP 45, it is stored to EEPROMs 49,50 datum address. The communication link is now open for connection. The ASIC 40 from the MCU-EEPROM 51,50 displays the amount of credits available on the PM on the LCD. During communication credits are checked continuously. The downloaded program enables the ASIC 40 to inform users when downfall limit is passed. For example, the credit units are not sufficient for remaining connection time. Consequently if the downcall limit is passed, the PM informs users to refill their credit cards. The credit checking mechanism can be accomplished in two ways. One checking method would be to read/write the credit units to the PPSC 41 each time a connection is established. When user makes a call, ASIC 40 records the credits valid on the PPSC 41 to the EEPROMs 49,50 via the MCU 51. During connection these credits drop to considerable units and are recorded onto the PPSC 51. The present SIM model allow users to store their phone number and individual names on their SIM XX cards. This data information includes

the name and the phone number. This indicates the magnetic coding mechanism (for the write unit) on the SIM XX card which could be replaced by credit portion of the SIM XX card. This would not be secure in credit filling system, since the SIM XX card could be copied, or reproduced to units of credits as users wish without the need for payment. The read only part could no be changed which belongs to the number it self.

The second solution of credit filling system would be to record the total amount of credits when its charged and manage the credit units within the PM without recording any information to the PPSC 41. This is established as follows: The MCU 51 via ASIC 40 reads and stores the time, date, and total amount of credits to EEPROMs 49,50. The EEPROMs 49,50 have temporary data storage area for update information. The algorithm residing in EEPROMs 49,50, are activated by MCU 51 to the DSPU 45. When a connection is established, the RF unit transmits the service code which is the phone encrypted phone number for identification. The credit units start to decrease during communication, and when connection ends, using PCM codec 46 the DSP 45 updates the remaining units of credits in EEPROMs 49,50 via the MCU 51. The present time, and date are also recorded to update old values corresponding to unit of charge corresponding to the old time, and date. The time function is required such that user might decide to have to recharge its credits on the same day in case he runs out of credits. Thus the MCU 51 via the DSPU 45 keeping records of time, and date records, by running algorithm adds the previous credit units to new datum units. This implies that users do not lose their previous credit units. The timer running within the unit keeps records of time, date, and remaining credit units even when the PM power is switched-off.

The PPSC 41 still contain credit units belonging to the corresponding charge date. This has no meaning since the EEPROMs 49,50 via the ASIC - MCU 40,51 records time and date of credit charge when a call connection is made. For communication the ASIC 40 continuously compares the date, and time functions of credit units valid on the PPSC 41 and EEPROM 49 via the MCU 51. If time units do not match, the credit units on the PPSC 41, they are simply rejected. Moreover, the same PPSC 41 cannot be used in another PM system since each PM system and PPSC 41 has unique ID code supplied by the manufacturer. Additionally, users are able to specify other UC's XY on their PM system for other PPSC to be used on the same PM. The PM reserves some addresses in the EEPROMs 49,50 to record the allowable UC XY to be used on the PM. If a specific UC XY is entered from the keypad, the PM checks the code verification pattern in the EEPROM 49 via ASIC-MCU 40,51. If the corresponding code matches, the PM opens for communication. The allowable record UC's XY to be stored on the PM will be limited. These aspects bring upto top level of security protection features of the new PM system.

At present mobile communication services is increasing enormously. The challenging future in mobile networks providing promising, secure, and easy access services enables us to achieve efficient, less costly, and secure mobile communication services. The new PM system satisfying the above conditions is designed to take role in technological changes in near future with its challenging frontier in communication networks.

Claims

1. A mobile telephone including means for storing data corresponding to the value of monetary units which have been prepaid and for use in enabling the value of credit units, date, time, and UC, for which the PM system includes means for reading the value of credit units, date, time, and UC in an encoded form, means for encrypting this form of data for communication, means for decrease of credit units during transmission and display of credit units, means for dialled number and cost of connectivity, means for limited PIN code request entries, means for card blocking facility, means for UC programmability, means for emergency credit purchase allowance, means for newly purchased credit accumulation, means for encrypted SC validation, means for protection of PPSC to be used in another PM phone, and means for blocking of the PPSC together with PM phone after incorrect entries of the UC.

2. A mobile telephone as claimed in claim 1 in which the data is stored on a subscribers identity module.

3. A mobile telephone as claimed in claim 1 or claim 2 in which the means for storing data is removable to enable the stored data to be updated.

4. The implementation of techniques, for use in updating the credit units, date and time of the PPSC includes the steps of inserting the PPSC into the PM, and transmitting data from the PPSC to a microcontroller unit, wherein the digital signal processing unit together with the microcontroller unit controls the updating of the credit units. The date and time on the PM's memory assessed by the credit cards facility via a transmission network, is transmitted by the user to the PM's facility by dialling via the network information including the UC and identification code. The amount by which the credit units on the PM's memory are to be decreased, is stored into the PM's memory together with present date and time. This process is achieved by the microcontroller unit which transmits the updated values of credit units, together with the date and time into the PM's memory.

5. The PPSC included within the PM system as claimed in claim 1 includes a read/write memory unit which is connected to the card reader.The card reader

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report) 15	Application number GB 9526041.0
Relevant Technical Fields (i) UK Cl (Ed.N) H4L (LSDK, LDSX, LECC) (ii) Int Cl (Ed.6) H04Q 7/22, 7/32, 7/38	Search Examiner MR N HALL
	Date of completion of Search 26 FEBRUARY 1996
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE: WPI	Documents considered relevant following a search in respect of Claims :- 1-4

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